# A nowcast for cyanobacterial harmful algal blooms (cHABs)?

- Focus sample collection when toxins are likely to be elevated

- Provide real-time swimming advisories to the public

- Help optimize drinking-water treatment and intake options for current conditions

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Objectives—cHAB recreational study

- Identify factors that can be used to predict toxin levels

- Use these factors to help understand what causes cHABs

  - Cyanobacterial molecular assays and cell counts

  - Phycocyanin and chlorophyll pigment measurements

  - Nutrient concentrations
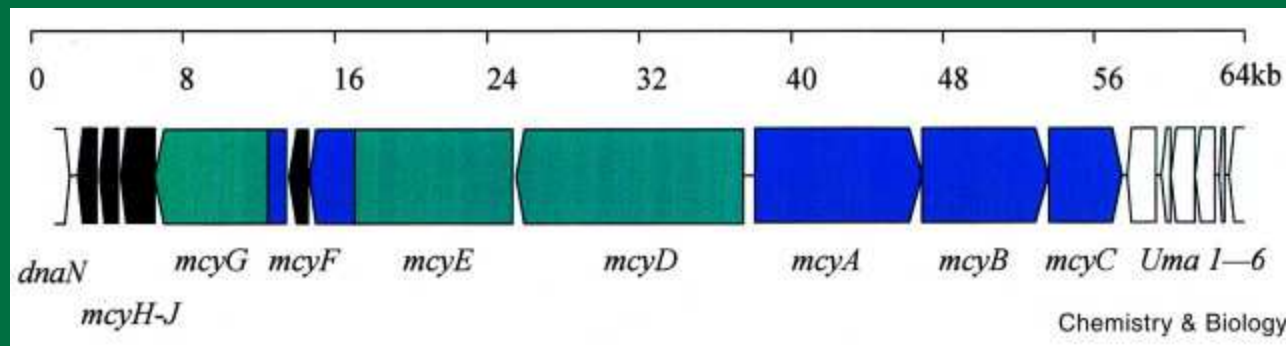
  - Weather and hydrology

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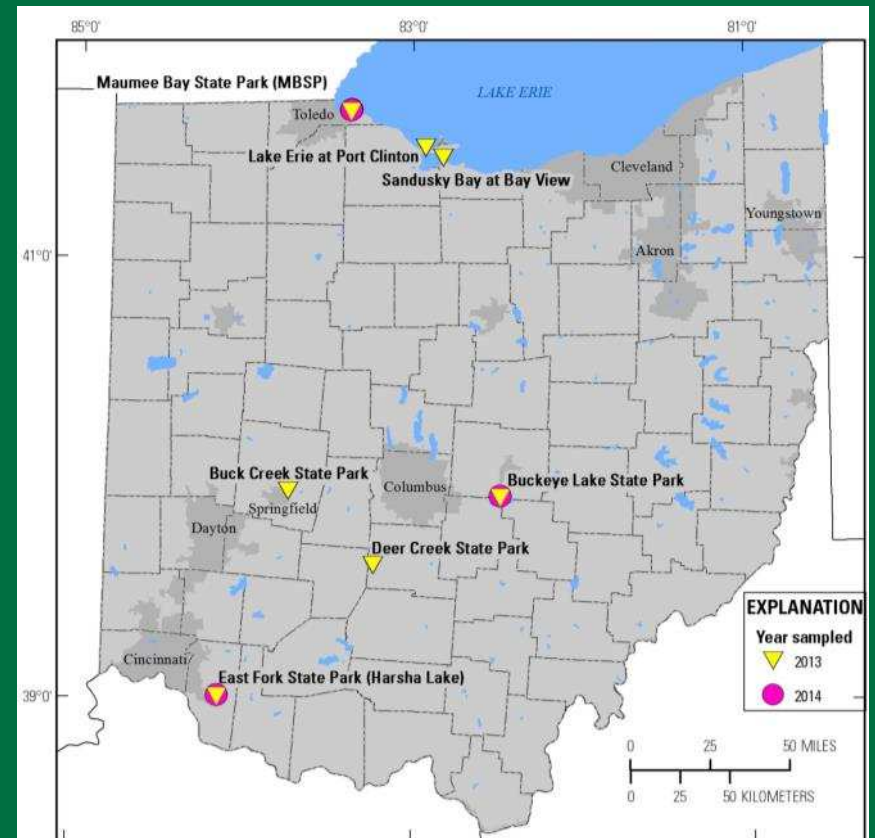
Sampling procedures

- Sampling weekly to monthly, May–Nov, 2013–14
- Composited 3 to 6 sub-samples
- In-situ measurements
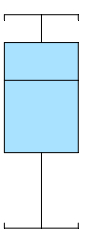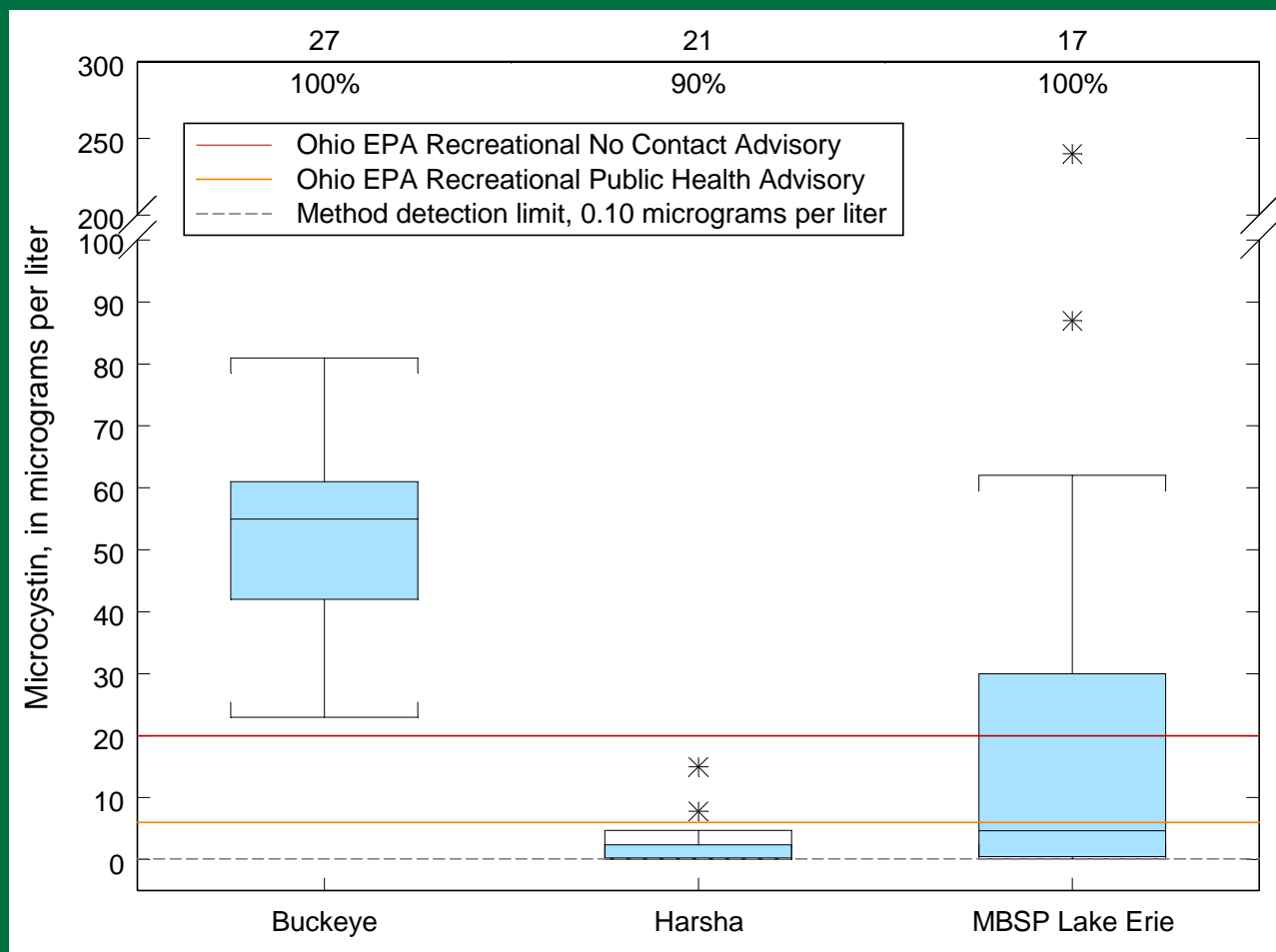- Split and preserved samples

Cyanobacterial qPCR assays

1. General cyanobacteria

2. General *Microcystis* and *Dolichospermum (Anabaena)*

3. Genus-specific *mcyE* assays for *Microcystis*, *Planktothrix*, and *Dolichospermum*—DNA for the presence of toxin gene

4. Genus-specific *mcyE* assays for above genera—RNA for the active expression of the toxin gene

Results 2014—Microcystin by ELISA

Two different modeling scenarios
(for predicting microcystin concentrations)

- **<u>Real-time</u>** models include factors that are easily or continuously measured

- **<u>Comprehensive</u>** models use factors that include results from a sample collected and analyzed in a laboratory

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Maumee Bay State Park

Imagery from U.S. Geological Survey
National Geospatial Program.

Lake Erie Beach

- 7 samples, 5/29–10/2/13
- 17 samples, 6/9–11/4/14

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Maumee Bay SP Lake Erie factors

Highest Spearman's correlations to microcystin (n=24, A=average)		
Real-time predictions	**rho**	**p**
Phycocyanin, turbidity, pH	0.76 – 0.85	<0.0001
Maumee River stream flow, daily mean, 3 d prior	-0.69	0.0002
Secchi depth	-0.67	0.0004
Algae category	0.62	0.0012
Streamflow, 14 d or 30 d, average or peak	-0.48 – 0.56	A0.0085
Comprehensive predictions		
Microcystis, cyanobacteria biovolume or abundance	0.84 – 0.87	<0.0001
Microcystis mcyE DNA, *Microcystis* by qPCR	0.73 – 0.82	<0.0001
Total phosphorus	0.78	<0.0001
Ammonia, nitrate + nitrite	-0.64 – -0.78	<0.0001
Microcystis mcyE RNA	0.58	0.0109

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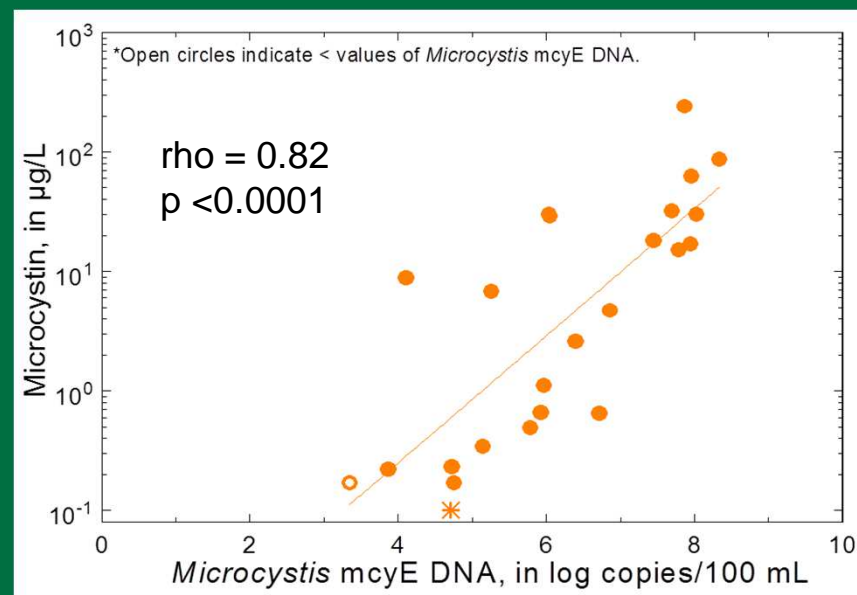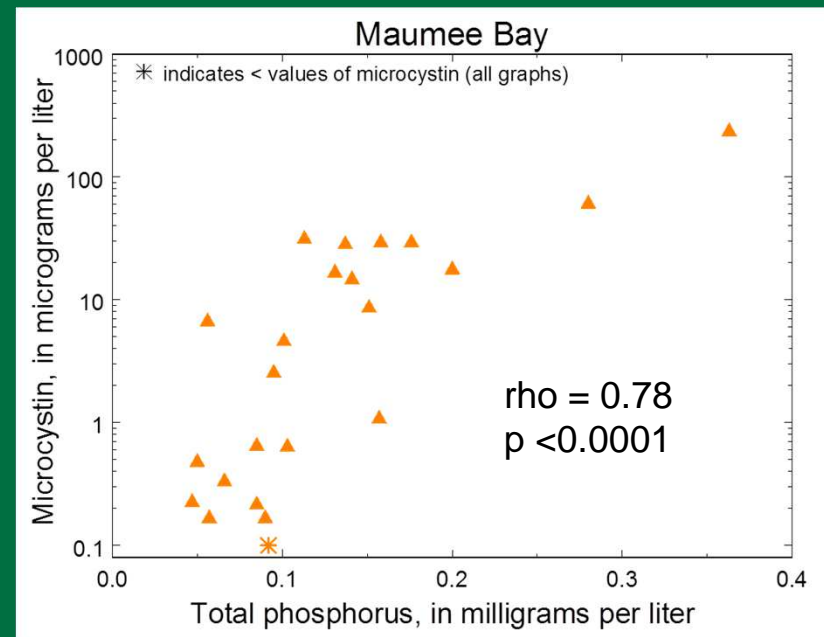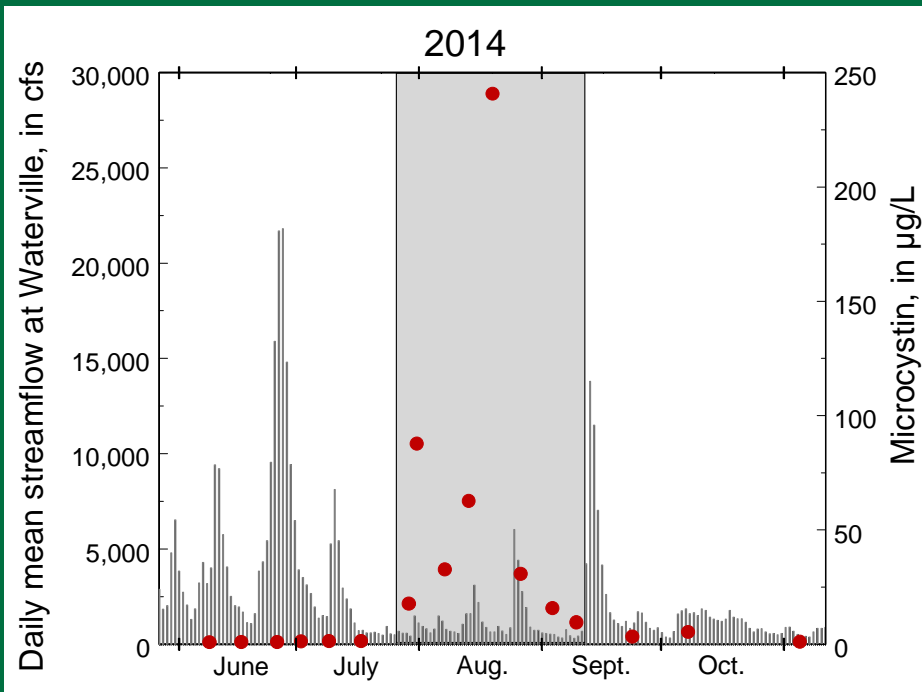
RAD5   Ditto still no predictions here

Robert A Darner, 10/19/2015

Factors significantly correlated to microcysin

RAD6   Buckeye Onion chart is the only one with a line.
would be nice if the fonts and axis titles on the charts all matched
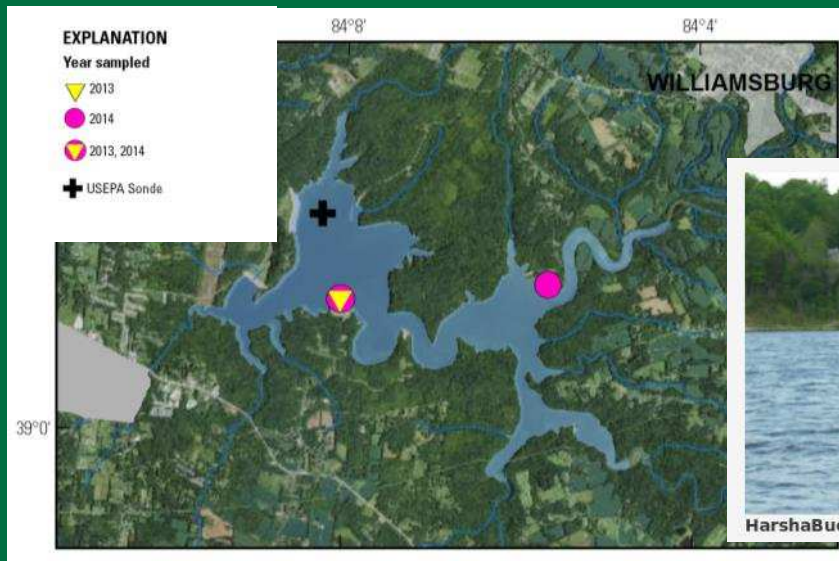Robert A Darner, 10/19/2015

Maumee Bay State Park models

Model type	Model variables	R^2	Sensitivity[a]	Specificity[a]
Real-time	Phycocyanin, streamflow previous day (Maumee R @ Waterville), algae category, wind speed at 8 a.m. TDZ Airport	0.82	92%	100%
Comprehensive	*Microcystis* BV, other microcystin producers BV, lake level change 14-day, phycocyanin	0.91	91%	100%
Comprehensive (no cell counts)	*Microcystis mcyE* DNA, pH, lake level change 14-day, nitrite concentration	0.90	82%	100%

[a] In terms of meeting or exceeding the Ohio Recreational Public Health Advisory of 6 ug/L for microcystin.

TURNING DATA INTO DECISIONS

Virtual Beach
Software for Developing Empirical Models of
Pathogen Indicators in Recreational Waters

U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory
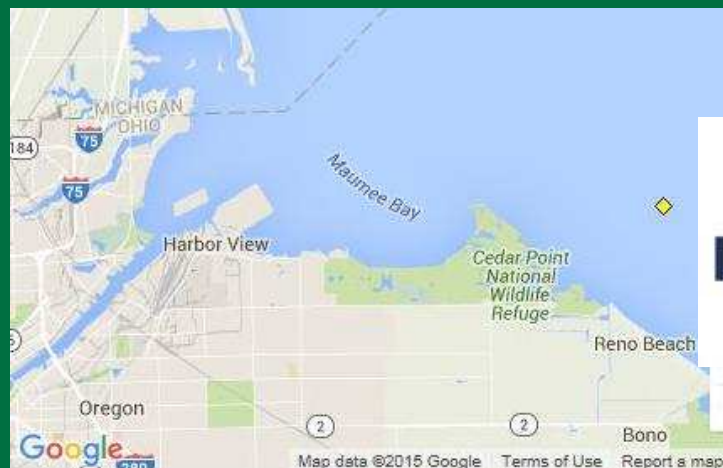Ecosystems Research Division

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Continuous monitor data

Harsha Lake
- 5/15–11/24/14

**Maumee Bay State Park**
- 8/7–11/6/14

RAD13   Can you label the Main and Campers Beaches?
Robert A Darner, 10/19/2015

Continuous monitor data and microcystin concentrations

Time period for each variable with highest correlation	Harsha (n=17)		Maumee Bay (n=8)	
	rho	p	rho	p
Phycocyanin, 7-day	0.98	<0.0001	0.96	<0.0001
Dissolved oxygen, 14-day	0.88	<0.0001	ND	ND
Oxidative reductive potential, 24-hr	ND	ND	-0.98	<0.0001
pH, 7-day or 14-day	0.83	<0.0001	0.77	0.0724
Temperature, instantaneous 10 a.m. or 14-day	0.73	0.0031	0.71	0.1108
Chlorophyll, 24-hour or 3-day	0.53	0.0358	-0.24	0.5706
Specific conductance, 3-day	-0.20	0.4473	-0.20	0.7040

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Real-time predictions of microcystin from phycocyanin
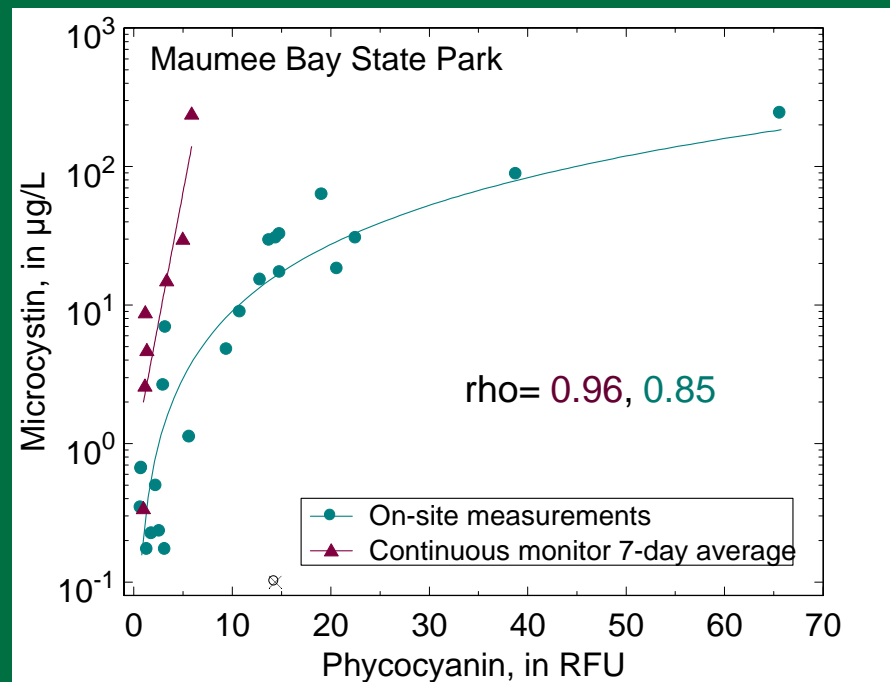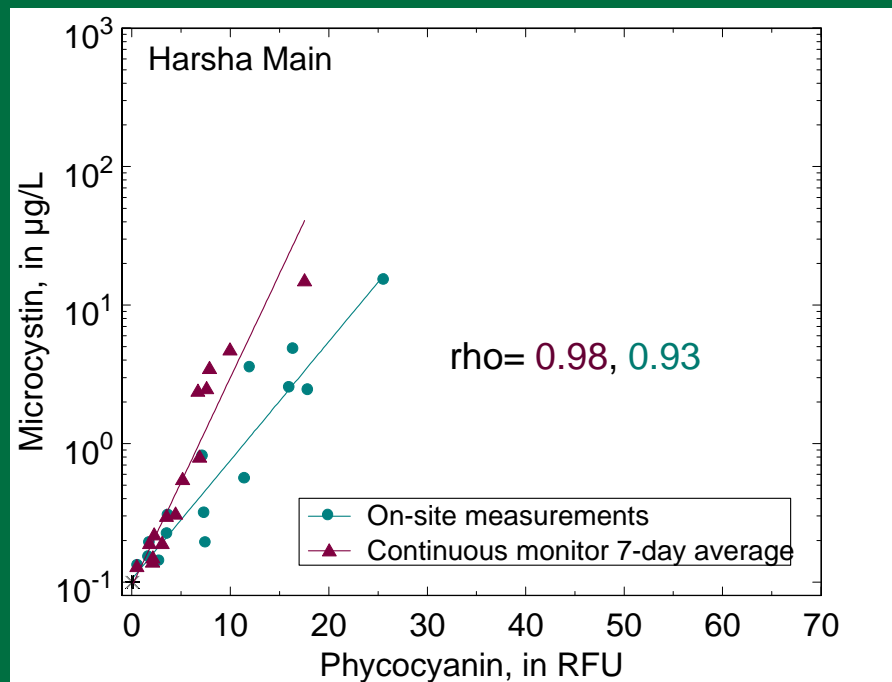
Continuous monitors—USEPA (Harsha) and LimnoTech (Lake Erie)

RAD9   MBSP On-site measurments is not a linear relation. try log transforming the x-axis.

Or loose the line :)
Robert A Darner, 10/19/2015

Conclusions

- Relations between factors and microcystin concentrations were site specific

- Continuous water-quality monitor measurements over multiple days showed the highest correlations to microcystin concentrations

- Environmental factors are promising for use in site-specific models for cHABs at freshwater lake sites.

- To develop accurate models, data need to be collected more frequently and for consecutive days

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Water Quality, Cyanobacteria, and Environmental Factors and Their Relations to Microcystin Concentrations for Use in Predictive Models at Ohio Lake Erie and Inland Lake Recreational Sites, 2013–14

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Thank you!